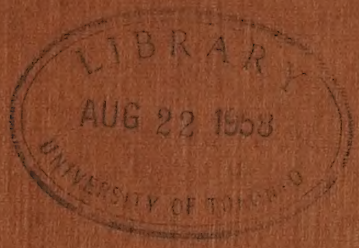


HYDRO-ELECTRIC INQUIRY COMMISSION

ENGINEERING DATA

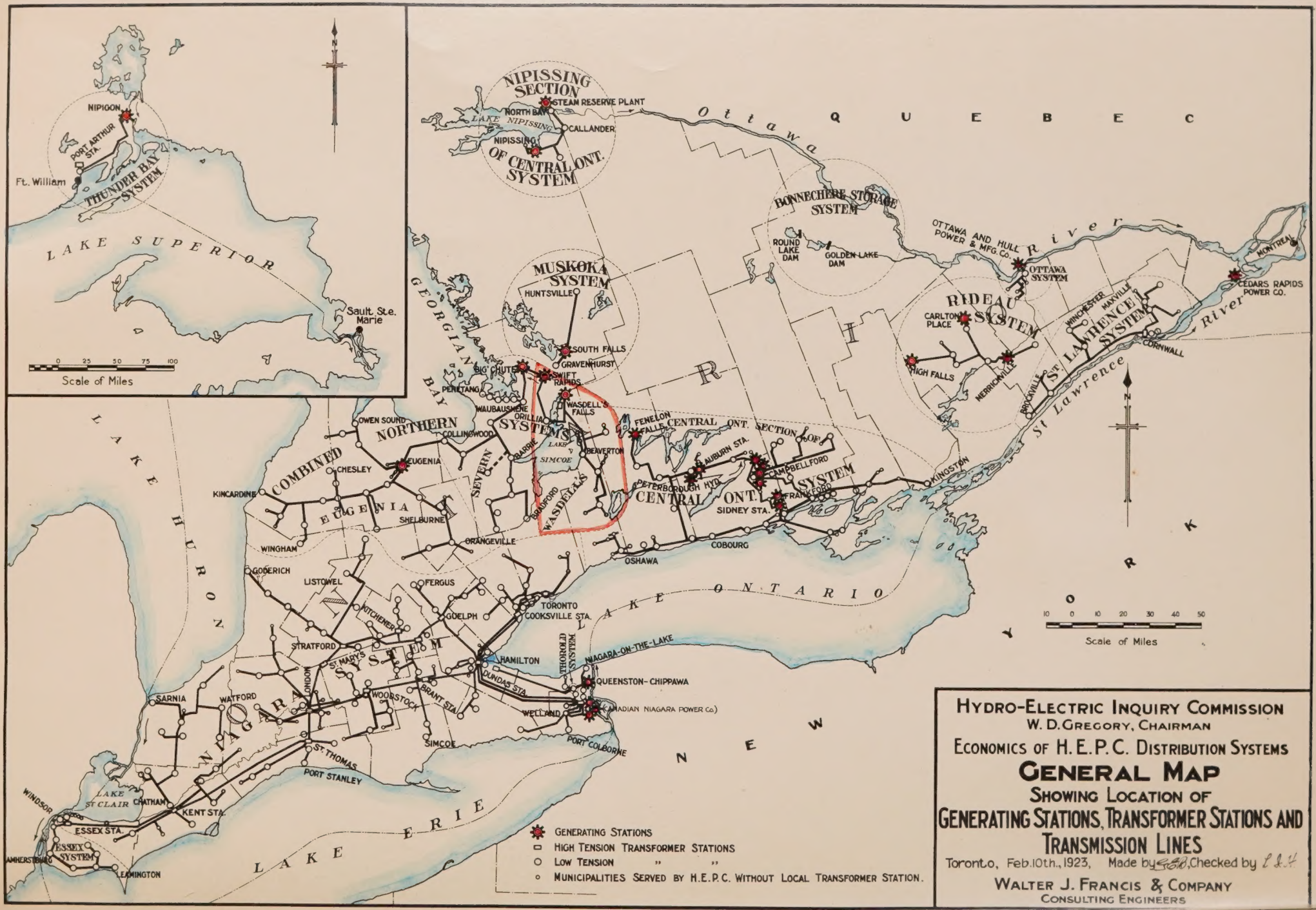
ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

STUDY OF WASDELL'S SYSTEM

WALTER J. FRANCIS & COMPANY

CONSULTING ENGINEERS

WASDELL'S SYSTEM



HYDRO-ELECTRIC INQUIRY COMMISSION

W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

GENERAL MAP

SHOWING LOCATION OF

GENERATING STATIONS, TRANSFORMER STATIONS AND TRANSMISSION LINES

Toronto, Feb. 10th., 1923, Made by G.S.B., Checked by L.S.H.

WALTER J. FRANCIS & COMPANY

CONSULTING ENGINEERS

To face frontispiece

General Map Showing Location of

Generating Stations, Transformer Stations and Transmission Lines

of the

Hydro-Electric Power Commission of Ontario.

The area outlined in red shows the

Wasdell's System.

 (Index)

INDEX TO WASDELL'S SYSTEM

INDEX TO WAGDELL'S SYSTEM

(Illus.)

LIST OF ILLUSTRATIONS

WASDELL'S SYSTEM

Toronto, Ontario,

March 2nd, 1923.

Hydro-Electric Inquiry Commission,
W. D. Gregory, Esq., Chairman,
T O R O N T O, Ontario.

re Studies of Engineering Economics of the
Wasdell's System of the
Hydro-Electric Power Commission of Ontario

Mr. Chairman and Gentlemen,-

In accordance with the letter to your Commission under date of November 4th, 1922, and your confirmation of the general instructions under date of November 15th, 1922, a study has been made of the engineering economics of the Wasdell's System of electrical generation and distribution operated by the Hydro-Electric Power Commission of Ontario. The work has been done under the direct personal supervision of Mr. Frederick B. Brown, M. Sc., M.E.I.C., a partner in the firm of Walter J. Francis & Company, in accordance with your instructions.

The subject has been discussed with Mr. Commissioner R. A. Ross in detail, and, generally, with Mr. Bower, the Secretary of your Commission, and constant communication has been maintained with the officials of the Hydro-Electric Power Commission of Ontario.

The reports of Messrs. Price, Waterhouse & Co. have been used as the basis of the financial figures given herein, and reference has been made to the records of the Hydro-Electric Power Commission of Ontario where it was necessary to do so to prepare the diagrams.

It is understood that it is not within the scope of the instructions to examine into any of the legal aspects of the System nor discuss any of the Acts of the Legislature relating to it.

The necessary technical data has required considerable preparation, as much of it is only available in the operating records of the Hydro-Electric Power Commission of Ontario. The printed reports contain a part, but these have had to be supplemented by interviews with various officials, and by searching the voluminous records both at the head office in Toronto and elsewhere.

The general plan under which the report of the studies is presented may be outlined as follows:

(1) A short review of the history and evolution of the System.

(2) A brief physical description of the System.

(3) A brief discussion regarding the characteristics of the local market.

(4) A discussion of progressive capital costs.

(5) Statistics regarding progressive revenues for various classes of service, with discussion thereon.

(6) Statistics regarding progressive operating costs and fixed charges, with discussion thereon.

(7) Statistics showing progressive and accumulated deficits or surpluses, with discussion thereon.

(8) Analysis of progressive operating records and of unit revenues per kilowatt-hour and per horse-power per annum and of unit costs per kilowatt-hour and per horse-power per annum.

(9) A brief discussion of the various important points concerning the System.

The report included herewith as pages 4 to 50 inclusive refers in detail to that portion of the activities of the Hydro-Electric Power Commission known as the Wasdell's System. References are made to the possible inter-connection of this System with other systems.

Throughout the report diagrams have been included in the order of the text, while the map included as a frontispiece shows the System generally and its geographical relation to all the other systems operated by the Hydro-Electric Power Commission of Ontario.

WASDELL'S SYSTEM

Frederick B. Brown, M. Sc.

Evolution and Development of the System.

The Wasdell's System had its beginning in 1913, when the Hydro-Electric Power Commission of Ontario purchased property adjoining Wasdell's Falls on the Severn River for the sum of $8,200.00, and undertook the construction of a hydro-electric power plant to supply power to the Beaverton and Cannington district.

The development of this water power was approved by an Order-in-Council under date of April 21st, 1913, and covered the following points:

"(1) The purchase of the riparian rights necessary for the development.

"(2) The purchase of the necessary material and equipment for the construction of the plant at Wasdell's Falls for the generation of electrical energy and its transformation, for transmission to the municipalities in the Cannington and Beaverton district.

"(3) The construction of transmission lines and transformer stations for delivery of power to the municipalities in the Cannington and Beaverton district, including both high and low voltage transmission lines."

The Wasdell's Falls generating station was ready for service on October 6th, 1914, and in November, 1914, the System began to serve four municipalities,

namely, Beaverton, Cannington, Sunderland and Woodville. Two transforming and distributing stations were constructed, one at Beaverton and the second at Cannington, and these were supplied from the generating station at 22,000 volts. The municipalities of Sunderland and Woodville were supplied over 4,000-volt feeders from the Cannington distributing station.

In January, 1915, the Village of Brechin was supplied with power at 4,000 volts from the distributing station at Beaverton.

As these municipalities did not require the entire output of the Wasdell's Falls plant, and the adjacent Severn System was in need of additional power, a tie line was constructed in 1916 from the nearest point on the Wasdell's System to Longford, at which point connection was made with the existing lines of the Orillia Water and Light Commission, which had its own development at Ragged Rapids on the Severn River. There already existed a tie line between the Ragged Rapids plant, belonging to Orillia, and the Big Chute plant on the Severn System of the Hydro-Electric Power Commission of Ontario. The two plants, Wasdell's Falls and Big Chute, were placed in normal parallel operation on July 24th, 1916, and the excess capacity of the Wasdell's Falls station was delivered to the Severn System. The Wasdell's plant was thus loaded to a point of economical operation and the load on the Big Chute plant was reduced.

On October 6th, 1916, a second tie line was completed and put into operation connecting the Eugenia System and the Severn System at the Collingwood distributing station, and from that date the Wasdell's, Severn and Eugenia Systems have been operated in parallel with one another, and also in parallel with the hydro-electric development of the Orillia Water and Light Commission,

which was originally located at Ragged Rapids, but late in 1917 was replaced by the new development at Swift Rapids near the old plant.

In June, 1920, the Police Village of Kirkfield and the Crushed Stone Company, Limited, of the same place, were added to the Wasdell's System, both being supplied from a distributing station in the village, the former at 4,000 volts and the latter at 575 volts.

Construction on the Wasdell's rural lines was started in 1918 in the vicinity of Beaverton, and at October 31st, 1921, rural lines were operated by Beaverton, Brechin, Sunderland and Woodville.

In the fall of 1922, the main transmission network was extended to Greenbank, from which point the municipalities of Uxbridge and Port Perry were served by a 4,000-volt line from the Greenbank distributing station.

Description of the System.

General.

The Wasdell's System lies east of the Severn System and embraces a narrow strip east and south of Lake Simcoe. The only power development on the System is at Wasdell's Falls. The System supplies municipalities between Brechin, Uxbridge and Port Perry, all located in Ontario County, with the exception of Kirkfield, which is in Victoria County. The transmission system extends roughly fifty miles north and south.

The map included as a frontispiece shows the whole of the transmission

COPY

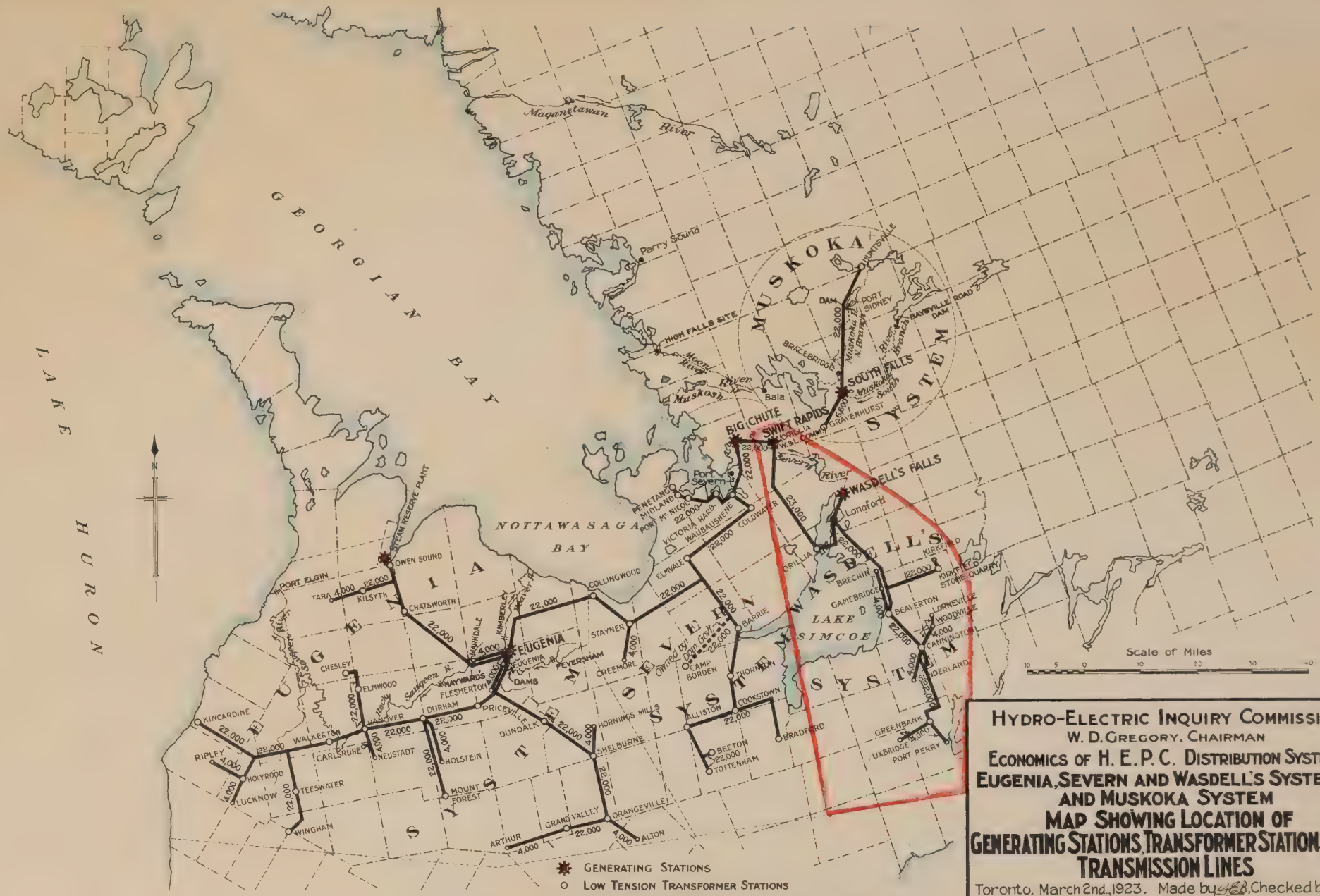
systems of the Hydro-Electric Power Commission of Ontario, with the location of generating stations, high voltage transformer stations, high voltage transmission lines and low voltage transformer stations clearly indicated, and shows the various systems in their relation to one another. The tinted portion of the map indicates the Wasdell's System.

The map included as page 8 shows the Wasdell's System on a larger scale than the frontispiece and gives also the names of the principal centres concerned. It shows also the Severn and Eugenia Systems which are inter-connected with the Wasdell's System for convenience of operation, these three systems together being known in the records of the Hydro-Electric Power Commission of Ontario as the Combined Northern Systems.

Speaking generally, the Wasdell's System consists of a hydro-electric generating plant at Wasdell's Falls on the Severn River, tie lines permitting interchange of power with the Severn and Eugenia Systems and the Swift Rapids plant of the Town of Orillia, and transmission lines feeding, at October 31st, 1922, eleven municipalities, and a considerable extent of rural lines.

Generating Station and Other Sources of Power Supply.

The only generating station at present constructed on the Wasdell's System is that at Wasdell's Falls on the Severn River, a short distance from its source at Lake Couchiching. The Swift Rapids plant of the Orillia Water and Light Commission is about fifteen miles further down the river and the Big Chute plant of the Severn System is about eight miles downstream from the Swift Rapids development, being only a short distance from the mouth of the



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS
EUGENIA, SEVERN AND WASDELL'S SYSTEMS, AND MUSKOKA SYSTEM

MAP SHOWING LOCATION OF GENERATING STATIONS, TRANSFORMER STATIONS AND TRANSMISSION LINES

Toronto, March 2nd, 1923. Made by H.E.B. Checked by [illegible]

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

(8)

Severn.

The hydro-electric plant at Wasdell's Falls was the first plant constructed by the Hydro-Electric Power Commission of Ontario and it was put into service on October 6th, 1914. The drainage area above the development is 2,075 square miles, and the water storage is 16,500 million cubic feet. The mean head at the turbines is 12 feet and the minimum head is 9 feet. A concrete dam 110 feet long and 18 feet high was constructed across the river and the power house forms a continuation of the dam. The dam and power house were built by Galbraith and Cate, of Montreal, at a cost of $37,617. The stop-log winch and head-gate lifting mechanism were purchased from Wm. Kennedy and Sons, of Owen Sound.

Two vertical shaft turbine units of 600 horse-power each supplied by the Boving Company of Canada, Toronto, for $21,900.00, are coupled to two 400-K.V.A., three-phase, 60-cycle, 2,300-volt vertical generators constructed by the Swedish General Electric Company. Seven 150-K.V.A. station transformers (one spare) step up the voltage from 2,300 to 22,000 volts for transmission to the distributing stations at Beaverton, Cannington, Kirkfield and Greenbank, and to the Severn System over the lines of the Orillia Water and Light Commission.

The capacity of this plant is approximately 860 horse-power at 80 per cent. power factor in accordance with the rating of the Hydro-Electric Power Commission of Ontario.

In 1921 the maximum demand was 860 kilowatts, the average output 427 kilowatts or 572 horse-power, and the load factor was 49.7 per cent.

The tie lines joining the Wasdell's System to the Severn System and to the Orillia Commission's System make it possible for either of these systems to deliver power to the Wasdell's System, but the amount of surplus power available from the other systems is small and very uncertain.

Parallel Operation of Wasdell's, Severn, Eugenia and Orillia Systems.

In order to make the excess power of the Wasdell's System available for the Severn System, a tie line was constructed in 1916 connecting the Wasdell's transmission system to the lines of the Orillia Water and Light Commission at Longford, there being already a tie line between the Orillia System and the Big Chute plant of the Severn System. Parallel operation of the Wasdell's and Severn Systems has been continued over the lines of the Orillia Commission since the date of connection, July 24th, 1916. A tie line 24 miles long connecting the Eugenia System with the Severn System at Collingwood was completed and put into service in October, 1916, paralleling the Wasdell's, Severn and Eugenia Systems. When the Swift Rapids plant of the Orillia Commission was put into service at the end of 1917, the tie line between the Big Chute plant on the Severn System and the Ragged Rapids plant of the Orillia Commission was replaced by a tie line between the Big Chute plant and the new development at Swift Rapids. Of the transmission lines joining the Wasdell's and Big Chute developments, the Hydro-Electric Power Commission owns the section from the Wasdell's Falls station to Longford, and from Swift Rapids to Big Chute, the intervening section extending from Longford to the Swift Rapids station being the property of the Town of Orillia.

When power is to be transferred from the Wasdell's System to the Severn System it is delivered by the Wasdell's System to the Orillia Commission at Longford where it is metered, and the Orillia Commission delivers an equal amount from the Swift Rapids plant to the Severn System, this power being metered at Swift Rapids.

When the connection was first made between the Wasdell's Falls generating station and the Orillia System at Longford, the Orillia Commission was short of power and was making very heavy demands on the Severn System. The Wasdell's System, therefore, delivered its excess power to the Orillia Commission and the Orillia Commission credited the Severn System with an equal amount of power. During November and December, 1917, while the Orillia Commission was transferring its source of supply to the new plant at Swift Rapids and abandoning the old plant at Ragged Rapids, which had been rendered useless on account of Trent Canal improvements, the demand of the Orillia Commission on the Severn System exceeded 2,000 horse-power, and a considerable portion of this amount was supplied by the Wasdell's System. In the records of the Hydro-Electric Power Commission of Ontario, the power from the Wasdell's System is considered to be supplied to the Severn System, and from it delivered to the Orillia Commission. The Severn System for some years purchased large amounts of power from the Eugenia System and the Wasdell's System, but by the end of the fiscal year 1921 the Eugenia System required the full output of the Eugenia Falls development and there was no surplus power for the Severn System. However, the Wasdell's System has still a few hundred horse-power available for the Severn System and the new plant at Swift Rapids not only supplies the total demands of the Orillia

System but has some surplus power which may be purchased by the Severn System. Any power which the Wasdell's System delivers to the Orillia Commission at Longford is delivered by the Swift Rapids plant to the Big Chute plant, and no charge is made for this interchange of power between the systems of the Hydro-Electric Power Commission due to parallel operation. Power from the Orillia Commission is only paid for by the Hydro-Electric Power Commission of Ontario when it is specifically ordered, and all power specifically ordered over and above the amount which Wasdell's delivers to Orillia is paid for at the rate of one-quarter of a cent per kilowatt-hour.

The parallel operation of these four plants has given very satisfactory service to the four systems concerned. The high head and large storage capacity of the Mugenia development make it very efficient as a peak load plant, and it is possible for it to draw power from the Severn System and conserve the water above the Mugenia development to be used during the period of peak load on the combined systems.

These plants serve that section of the Province of Ontario which lies between Port Perry and Uxbridge in Ontario County on the extreme east, and Tara and Kincardine in Bruce County on the extreme west, comprising two-thirds of Ontario County, a small portion of Victoria County, all of Simcoe County, Dufferin County, Grey County and Bruce County, and a small portion of the northern sections of Wellington and Huron Counties.

Undeveloped Power Sites on the Wasdell's System.

There are no undeveloped power sites on the Wasdell's System which have

sufficient capacity to warrant their development, and when the demand on the System exceeds the capacity of the present development, power must be developed at or purchased from some source outside the boundaries of the Wasdell's System.

Miscellaneous Power Plants in the District.

The only power development of any kind on the Wasdell's System, other than the development at Wasdell's Falls, is the hydro-electric development at Swift Rapids owned by the Orillia Water and Light Commission. This development, and the Town of Orillia, which it supplies, are within the boundaries of the Wasdell's System, but do not form a part of it. For some years the Orillia Commission purchased power from the Big Chute plant of the Severn System in accordance with a contract made with the Simcoe Railway and Power Company which constructed and owned the Big Chute plant and from whom it was purchased by the Hydro-Electric Power Commission of Ontario. At the present time the Orillia Commission has some surplus power which may be purchased by the Hydro-Electric Power Commission either for the Severn System or the Wasdell's System.

In view of the fact that the Swift Rapids plant is operated in parallel with the three plants of the Hydro-Electric Power Commission at Wasdell's Falls, Big Chute and Eugenia Falls, a short description of the development is included.

The Swift Rapids development is located on the Severn River about midway between the Wasdell's Falls and Big Chute developments. It is about twenty miles from Orillia and is owned and operated by the Municipality of Orillia. The concrete dam forms a part of the Trent Canal System (Severn Division). It is seventy-five feet high and two hundred and thirty feet long with five

stop-log sluices, each 20 feet wide. From the northerly end of the dam, three concrete flumes, 55 feet long and 20 feet by 24 feet in section, lead to three pits, adjacent to the concrete power house, where a head of 47 feet is available. Three 2,120 horse-power turbines, each direct-connected to a 1,500-K.V.A., 3-phase, 60-cycle, 2,300-volt generator, supply power to three 3-phase, 1,500-K.V.A. transformers which step the voltage up from 2,300 to 23,000 volts for transmission to Orillia. The plant gives continuous service and was installed in 1917 at a stated cost of $114,000, exclusive of the building and development which it is understood were constructed by the Federal Government. The municipality had, from 1901 to 1917, a plant of about 1,600 horse-power capacity under a head of 35 to 41 feet at Ragged Rapids which was replaced by the present plant.

Transmission Lines.

Up to October 31st, 1921, the Hydro-Electric Power Commission had constructed on the Wasdell's System 78.7 miles of transmission and distribution lines; of these 23.3 miles of 4,000-volt lines distribute power from the high voltage distributing stations to the smaller municipalities and the rural lines, the remaining 55.4 miles are operated at 22,000 volts and form a network supplying the larger municipalities, and also connecting together for parallel operation, the generating stations of the Wasdell's, Severn and Eugenia Systems and the Swift Rapids station of the Orillia Water and Light Commission.

The transmission system is constructed on wooden poles throughout and presents no extraordinary features. Extensions estimated to cost about $120,000

for 1922 and $35,000 for 1923 are said to be contemplated, covering stations and lines to supply Uxbridge and Port Perry, and for miscellaneous improvements and for considerable extensions to the rural lines.

Transforming and Distributing Stations.

The transmission lines feed the various municipalities at low voltage through three substations, which are listed in the table below, showing their voltage and capacity:

Table of Transforming and Distributing Stations

Location	K.V.A. Capacity	Voltage H.V.	Voltage L.V.	Remarks
Beaverton	300	22,000	2,300	Supplies Beaverton and Brechin at 4,000 volts.
Cannington	300	22,000	2,300/575	
Kirkfield	225	22,000	2,300/575	Supplies Kirkfield at 4,000 volts, and the Crushed Stone Company at 575 volts.

Note: These transformer banks are connected in star on the L.V. side to give 4,000 volts for distribution in the municipalities and to supply the rural lines operated by them.

Local Distributing Systems.

With the exception of the rural lines there are no municipalities on the Wasdell's System in which the Hydro-Electric Power Commission distributes retail power to consumers. The Commission acts as a wholesale distributor only and in

all the municipalities the electricity is distributed by the municipality itself or by local commission in the municipalities. It is understood that the accounting for all of the municipalities of the Wasdell's System is done in accordance with the standard accounting system of the Hydro-Electric Power Commission, and the details for the various municipalities are given in the Annual Reports.

Characteristics of Market.

Population Served and Percentage of Consumers to Population.

The district served by the Wasdell's System is both urban and rural but the rural lines comprise a larger proportion of the total transmission system than in the other systems. Only three towns, Beaverton, Cannington and Woodville were billed with over 50 horse-power in 1921. A comparatively large block of power is delivered to the Severn System. Orillia is by far the largest power consumer in the district but it is not one of the partner municipalities regularly served by the Hydro-Electric Power Commission of Ontario. The Orillia Water and Light Commission has its own development at Swift Rapids, and has an agreement with the Hydro-Electric Power Commission of Ontario permitting the exchange of power in either direction between the Swift Rapids plant of the Orillia Commission and the Wasdell's Falls, Big Chute and Eugenia Falls plants of the Hydro-Electric Power Commission, these four plants being regularly operated in parallel.

The following table gives in detail the number of consumers at the end of the fiscal year 1921 in the places served by the System, the approximate horse-power billed to each place in 1921, together with the average horse-power per consumer. The figures are useful for comparison with other systems, although they should be used with caution. No figures for kilowatt-hours consumed are available.

Table of Market Statistics

Municipality	Population	No. of Consumers	Percentage Consumers to Population	H.P. Billed 1921	H.P. Billed per Consumer
Beaverton	975	325	33.3	103.2	0.32
Brechin	(500)	53		28.4	0.53
Cannington	896	263	29.3	80.4	0.31
Kirkfield	(500)	37		25.8	0.70
Sunderland	(500)	132		45.7	0.35
Woodville	448	128		54.7	0.43
Totals	3,819	938	24.5	338.2	0.36

In the Annual Reports of the Hydro-Electric Power Commission the letters P.V. appear in place of population in the cases of a number of the smaller municipalities. In compiling the figures in the Annual Reports for total population, a round figure of 500 is added for each of these places. This number has been included in this report as the population of each of these places in obtaining the average horse-power billed per capita for 1921. The average horse-power billed per consumer in 1921 was 0.36 and the average horse-power billed per capita was 0.09.

Growth of Market and Ultimate Sources of Power Supply.

Since the commencement of operations the growth of the System has been fairly steady. The loads on the System were as follows, the figures being given in horse-power for the month of October in each year: 1915, 209; 1916, 250; 1917, 275; 1918, 261; 1919, 326; 1920, 452; 1921, 399. These figures are the sum of the loads in October for the various municipalities and do not show the actual peak demands on the System, but they do indicate the growth of the demand. The amount of power sold to the Severn System for these years has not been included as it does not represent a growth of the Wasdell's System.

Owing to the inter-connection of the Wasdell's, Severn and Eugenia Systems, and the methods of keeping the records by the Hydro-Electric Power Commission of Ontario, it is impracticable to separate the records satisfactorily so as to indicate the actual peak on any one part of the Combined Northern Systems. Briefly, it may be noted that in 1921, the total of loads billed to the municipalities is nearly twice as great as it was in 1915, the year in which the Wasdell's System began operations.

The ratio of consumers to population at the end of 1921 was 24.5 per cent. which compares well with other systems. The general growth in the load and in the number of consumers has been comparatively steady making due allowance for the abnormal conditions following the armistice in November 1918, and the indications are that the demands are still increasing.

At the present time the Wasdell's System is loaded to the full capacity of the plant, if the supply of about 400 horse-power to the Severn System is

included. If this load be withdrawn from the Severn System and used on the Wasdell's System it would probably take care of the normal growth of the System for three or four years but before then the future source of power supply must be considered. If Niagara power is to be used for the Combined Northern Systems it would necessitate the building northwards of a number of short tie lines which must be connected to the Wasdell's, Severn and Eugenia Systems through frequency changers, since Niagara power is developed at 25 cycles.

To use power from the French River for the Muskoka System and for the Combined Northern Systems, and possibly for the Nipissing Section and for the northerly portion of the Trent Section of the Central Ontario System, long transmission lines from the French River to Nipissing, and from Nipissing to Muskoka, and from Muskoka to Wasdell's and to the Trent Systems would be required. As all of these Systems are operated at 60 cycles, the use of French River power, which is contemplated at 60 cycles, would avoid the use of frequency changing apparatus. The development of the French River sites would depend on the growth of the load on the Combined Northern Systems, and in the North Bay-to-Sudbury district to a sufficient degree to permit of their economical use. If the general power demand continues to increase at a rapid rate, the total economical capacity of the French River sites, which is probably about 20,000 horse-power, might be reached within a comparatively few years, in which case Niagara power would be the only feasible source of supply. From an operating point of view it would be preferable to use power generated at 60 cycles, and avoid the complication of frequency

changers. It is understood that the Hydro-Electric Power Commission contemplates the use of some Niagara power through frequency changers in the near future for the Eugenia System.

If Niagara power be used, or, possibly, power from the Central Ontario System, it might prove desirable to separate a number of the municipalities from the present partnership arrangement on the Wasdell's System and add those municipalities to the Niagara or Central Ontario System, in which case the accounting should take into consideration the re-allocation of the cost of that portion of the system so affected.

On the other hand, if power be transmitted from the French River, a system of billing for each of the four or five systems affected would have to be developed so as to fairly apportion the costs of the transmitted power.

Capital Costs.

General.

The figures of capital costs given in the table on the following page and plotted diagrammatically, and shown on the sheet of curves included as page 22 were obtained from page 5 of the report on the accounts of the Wasdell's System by Messrs. Price, Waterhouse & Co. to the Hydro-Electric Inquiry Commission under date of November 7th, 1922, except for the years

1914 to 1916 inclusive, which were obtained from the Annual Reports of the Hydro-Electric Power Commission:

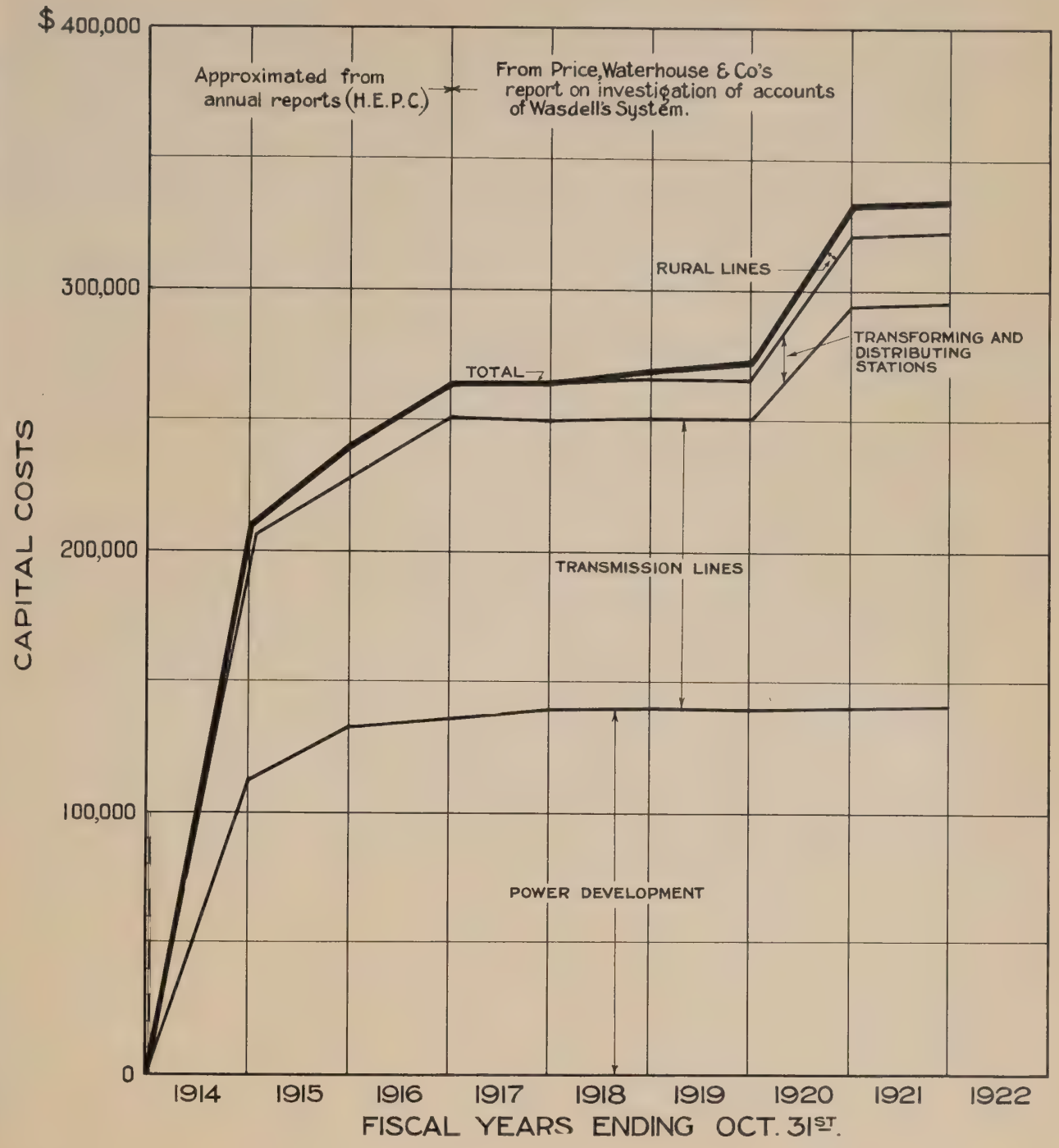
Table of Progressive Capital Costs

Capital Assets	Fiscal Year Ending October 31st, 1914	1915	1916	1917
Power Development	$112,832	$132,907	$136,658	$139,913
Transmission Lines	94,051	95,234	114,406	110,298
Transforming and Distributing Stations	3,444	13,430	13,637	14,520
Rural Lines	-	-	-	-
Total	$210,327	$241,571	$264,701	$264,731

Table of Progressive Capital Costs (continued)

Capital Assets	Fiscal Year Ending October 31st, 1918	1919	1920	1921
Power Development	$140,563	$140,787	$141,760	$141,885
Transmission Lines	110,470	110,243	153,690	154,189
Transforming and Distributing Stations	14,735	14,736	26,215	26,909
Rural Lines	4,357	7,698	11,282	12,399
Total	$270,125	$273,464	$332,947	$335,382

It will be noted that the total capital costs to the end of 1921, amounting to approximately three hundred and thirty-five thousand dollars, is divisible roughly into one hundred and forty-two thousand dollars for the plant at Wasdell's Falls, one hundred and fifty-four thousand dollars for transmission lines, twenty-seven thousand dollars for distributing



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN
ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

WASDELL'S SYSTEM
PROGRESSIVE CAPITAL COSTS

Toronto, Mar. 2nd., 1923. Made by G.E.B. Checked by L.L.K.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

stations and twelve thousand dollars for rural lines.

The increase of $43,891.00 in the investment in transmission lines consists chiefly of expenditures incurred subsequent to 1917, in stringing aluminum cable to replace steel cable, and installing a second telephone circuit between Wasdell's Falls and Parkham Junction.

The increase in the investment in distributing stations incurred in 1920, consists chiefly of expenditures made in the construction of a new station at Kirkfield. It has been estimated that additional funds of $120,000 and of $35,000 will be required for the Wasdell's System for the years 1922 and 1923 respectively, to be expended as follows:

Particulars	Year Ending October 31st, 1922	1923
Stations and Lines for Uxbridge and Port Perry	$55,500	-
Miscellaneous Betterments	10,000	$10,000
Rural Expenditures	54,500	25,000
	$120,000	$35,000

If these proposed extensions to the rural lines are carried out, the expenditures on rural lines will have increased from $4,357.00 on October 31st, 1917, to approximately $92,000.00 at October 31st, 1923, which is about 65 per cent. of the expenditure in the power development.

The present sub-divided costs of the Wasdell's Falls plant are as follows: land and water rights, $2,140; dams and water structures, $19,083; power house, $50,113; equipment, $64,544; intangible assets, none; total $141,885.

COPY

Power Data.

The table below, and the diagram included as page 25 have been prepared to show the characteristics of the Wasdell's System in terms of horse-power:

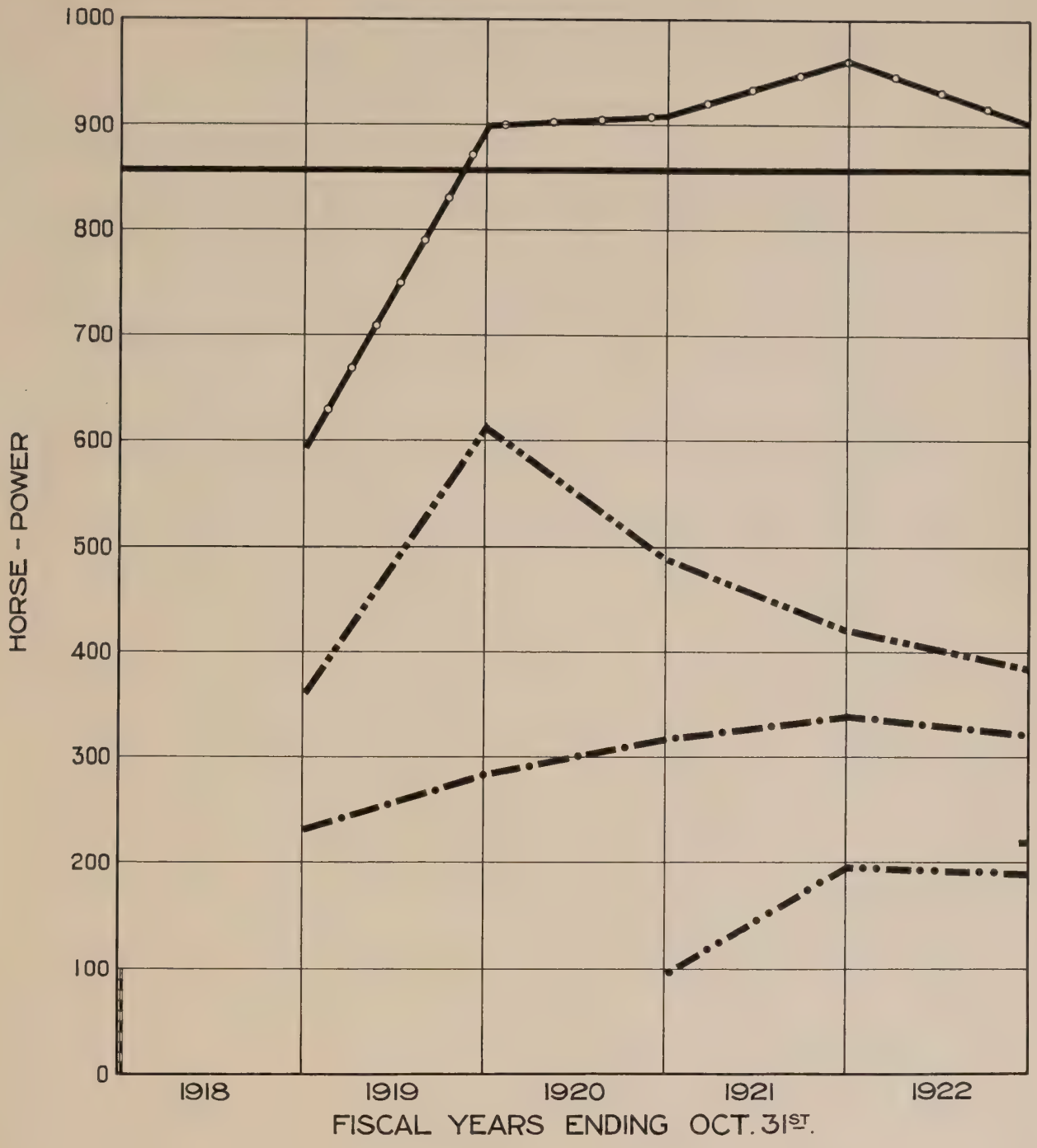
Table of Horse-power Developed, Consumed, Billed, Etc.

	Fiscal Year Ending October 31st,					
	1914-17	1918	1919	1920	1921	1922
H.P. Developed	860	860	860	860	860	860
H.P. Consumed, Average (estimated)						221.0
H.P. Billed, Total		597.4	901.1	910.0	962.5	903.8
H.P. Billed to Municipalities		234.6	287.7	319.5	340.8	322.5
H.P. Billed to Private Companies (The Crushed Stone Company, Limited)				98.4	198.5	191.9
H.P. Billed to Severn System		362.8	613.4	492.1	423.2	389.4

It will be noted that there are six different classes of horse-power shown in the table and on the diagram. These may be explained as follows:

Developed Horse-power.

The figures for plotting the curve showing developed horse-power were obtained from the records of the Hydro-Electric Power Commission and are the sum of the capacities of the various units installed in the Wasdell's Falls station expressed in horse-power at 80 per cent. power factor according to the usual Hydro-Electric Power Commission rating.



H. P. DEVELOPED
H. P. BILLED, TOTAL PER ANNUM
H. P. BILLED PER ANNUM TO MUNICIPALITIES
H. P. " " " " PRIVATE COMPANIES
H. P. " " " " SEVERN SYSTEM
H. P., AVERAGE CONSUMED PER ANNUM

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WASDELL'S SYSTEM
HORSE-POWER DATA

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Average Horse-power Consumed.

The average horse-power consumed on the Wasdell's System (not including the energy delivered to the Severn System) has been derived from the total number of kilowatt-hours estimated by the Hydro-Electric Power Commission as being the total kilowatt-hours supplied to the Wasdell's System for the year ending October 31st, 1922. The derivation was made by dividing the total kilowatt-hours per annum by 8,760, being the number of hours in a year, and reducing to horse-power by dividing by the factor 0.746. No records are available for the previous years.

Billed Horse-power.

The curve of total horse-power billed was plotted from data given in Exhibit L-A, in the report of Price, Waterhouse & Co. on the "Investigation of the Accounts of the Wasdell's System", dated November 7th, 1922, Hydro-Electric Inquiry Commission File No. 196-a-3, dated November 11th, 1922. A subdivision has been made between the horse-power billed to municipalities on the Wasdell's System, horse-power billed to a private company, (the Crushed Stone Company, Limited), and the horse-power billed to the Severn System.

A study of these curves shows a very slow growth in the demand of the municipalities of the Wasdell's System, and even a slight falling off in the fiscal year ending October 31st, 1922. It is interesting to note that for the last three years the curve of total billed horse-power lies above the developed horse-power due to the large demand of the Severn System for the

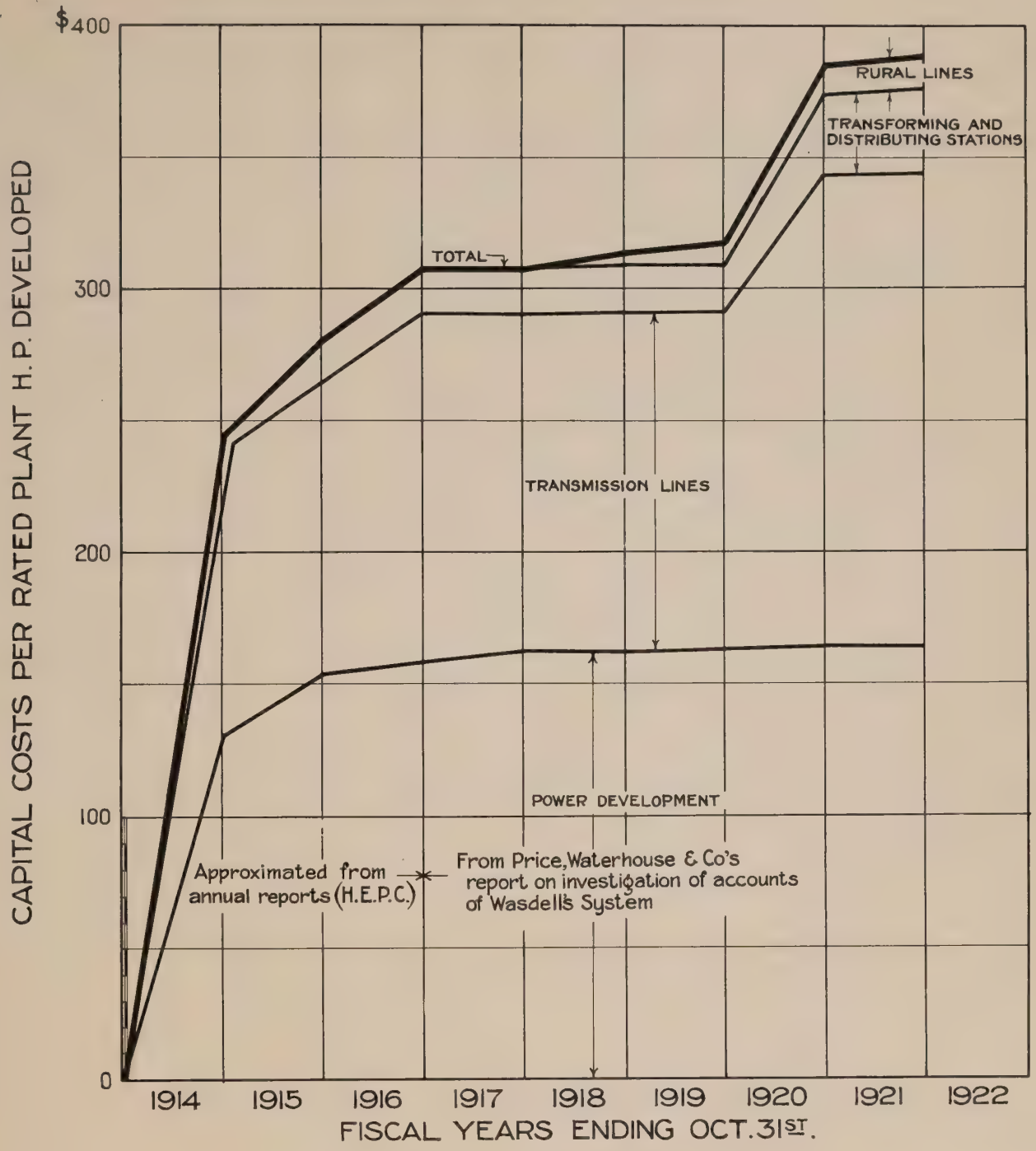
surplus power from the Wasdell's System. Apparently the surplus power which is at present supplied to the Severn System is sufficient to take care of the normal growth of the demand of the Wasdell's System for some years to come.

Capital Costs per Horse-power Developed.

The diagram included as page 28 and the following table indicate the fractional capital costs per rated plant horse-power developed at different points of delivery based on the figures showing the capital costs of the System, and the horse-power data given above. This sheet of curves, therefore, indicates the capital costs per rated plant horse-power with the spaces between adjacent curves indicating that portion of the total (delivered) capital cost per horse-power chargeable against each of the items of the table, as follows:

Table of Capital Costs per Rated Plant Horse-power Developed

	Fiscal Years Ending October 31st, 1914	1915	1916	1917
Power Development	$131.20	$154.50	$158.90	$162.70
Transmission Lines	109.40	110.70	133.00	128.20
Transforming and Distributing Stations	4.00	15.60	15.80	16.90
Rural Lines	-	-	-	-
Total	$244.60	$280.80	$307.70	$307.80



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WASDELL'S SYSTEM
CAPITAL COSTS PER HORSE-POWER DEVELOPED

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Table of Capital Costs per Rated Plant Horse-power Developed, (continued)

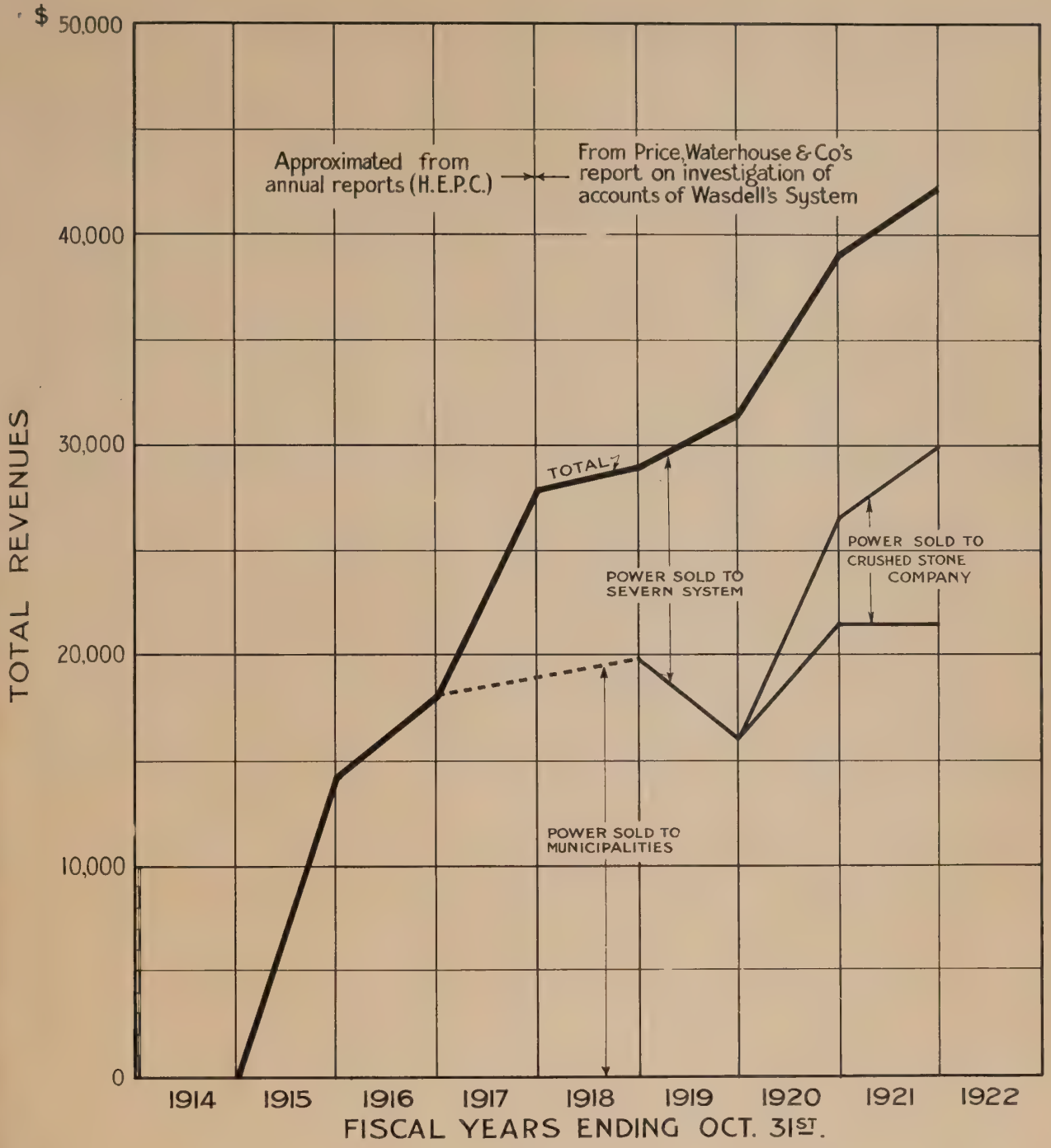
	Fiscal Years Ending October 31st, 1918	1919	1920	1921
Power Development	$153.40	$153.70	$164.30	$165.00
Transmission Lines	128.50	128.20	178.70	179.30
Transforming and Distributing Stations	17.10	17.10	30.50	31.30
Rural Lines	5.10	9.00	13.10	14.40
Total	$314.10	$318.00	$387.10	$390.00

Total Revenues.

The table on page 31 giving the total revenues of the Wasdell's System has been prepared by using the figures of Exhibit I, supplemented from page 8 of the report on "Investigation of Accounts of Wasdell's System", dated November 7th, 1922, Hydro-Electric Inquiry Commission file No. 196-a-3. This applies to the years 1918 to 1921 inclusive. The figures for the years 1915 to 1917 inclusive were obtained from the Annual Reports of the Hydro-Electric Power Commission. The sheet of curves on page 30 shows the revenues in graphic form.

The municipalities were charged with the cost of power and the distribution thereof and with that portion of the fixed charges which pertained to the power supply. They obtained certain reductions in cost over the whole period, because they were credited with any profit arising from sales of power to the Severn System. The power sold to the Crushed Stone Company, Limited, was

Total				



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WASDELL'S SYSTEM
TOTAL ANNUAL REVENUES
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charged with its proportion of operating expenses and fixed charges, and whatever profit or loss was realized or incurred was transferred either to accounts with municipalities or to the reserve for contingencies. The table of revenues is as follows:

Table of Total Annual Revenues for Various Classes of Customers

	Fiscal Year Ending October 31st,						
	1915	1916	1917	1918	1919	1920	1921
Power Sold to Municipalities	$14,308			$19,975	$15,215	$21,650	$21,589
Power Sold to the Crushed Stone Co.						5,097	8,440
Power Sold to Severn System				9,125	15,509	12,417	12,363
Totals	$14,308	$18,155	$28,008	$29,100	$31,724	$39,164	$42,392

Total Costs of Power.

The table on page 33 shows the cost of power subdivided under various headings for the years 1915 to 1921 inclusive. The figures from 1918 to 1921 inclusive are made up from Exhibit I of the Price, Waterhouse & Co. report dated November 7th, 1922, while the figures for the years 1915 to 1917 inclusive were obtained from the Annual Reports of the Hydro-Electric Power Commission.

The headings under which the various costs have been grouped are as follows:

Operating Costs.

Operating costs include the wages of power house operators, linemen, station attendants and so forth, power purchased from other sources, supplies and all miscellaneous items usually grouped under this item.

Maintenance.

Under maintenance have been placed all the items for labour and materials charged in the books of the Commission as against the individual portions of the plant, stations, lines and distributing stations, and these have been grouped together from the individual figures of the Price, Waterhouse & Co. report to make one item.

Overhead and General Expense.

Under the heading of overhead and general expense are such items as salaries of local officers and clerks, printing and stationery, stores operation, taxes, insurance, rents, legal expense, miscellaneous office supplies and so forth, all in accordance with the Price, Waterhouse & Co. report, supplemented for the years 1915 to 1917 from the Annual Reports of the Hydro-Electric Power Commission.

Interest, Renewals, Sinking Fund and Contingencies.

The figures for interest include all interest charges shown for the capital

invested in the System. The renewal account includes all items shown as chargeable against renewals in the same report, while the figures for sinking fund and contingencies have been transferred directly from the report.

The sheet of curves on page 34 is the direct plotting of the figures in the table below, with the spaces between adjacent curves indicating the amount chargeable against that particular item. The figures are as follows:

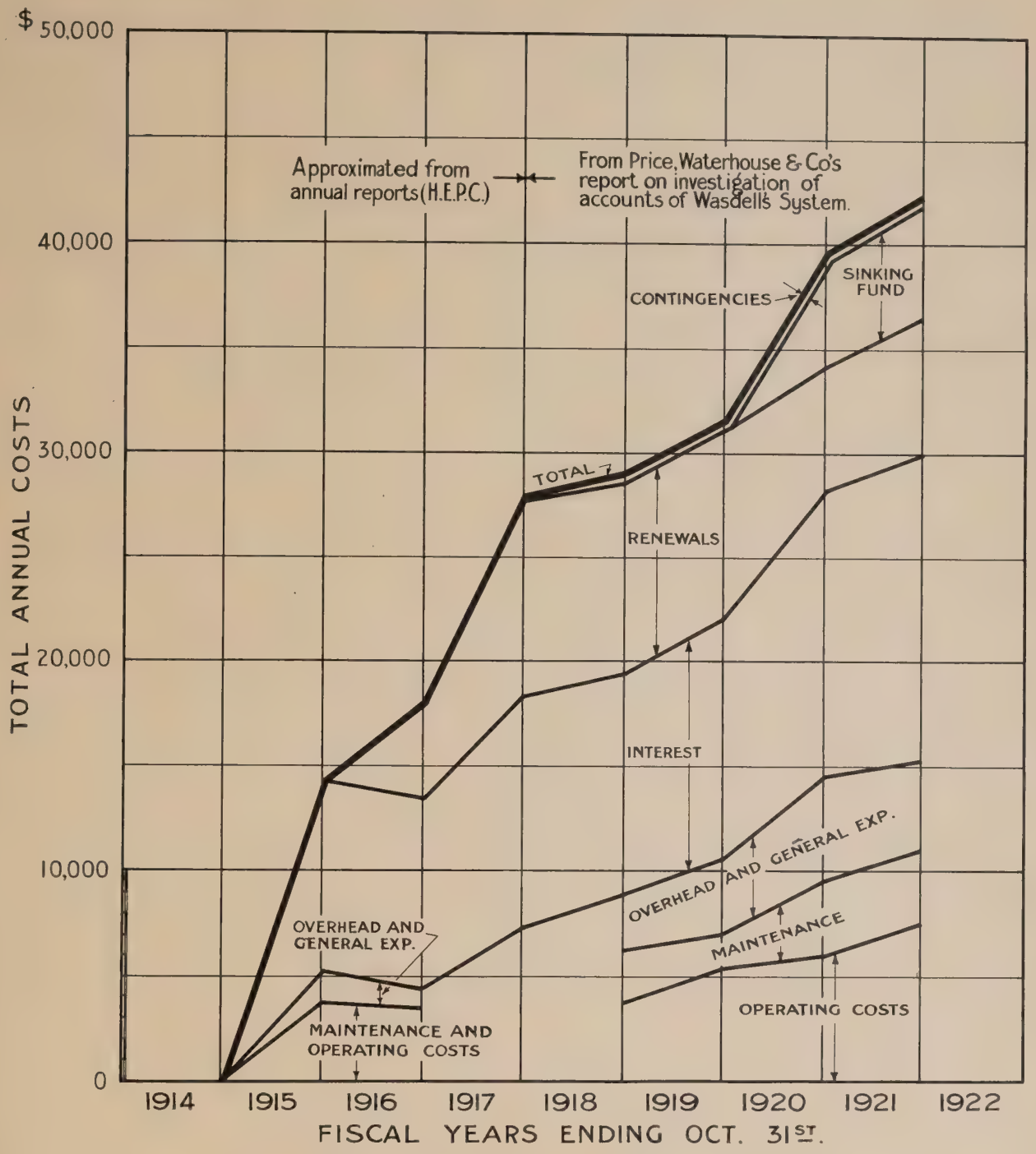
Table of Total Annual Costs of Power

	Fiscal Years Ending October 31st,						
	1915	1916	1917	1918	1919	1920	1921
Operation	($ 3,608	[illegible]		$ 3,797	$ 5,351	$ 6,107	$ 7,708
Maintenance			($ 7,372	2,536	1,738	3,563	3,343
Overhead and General Expense	1,465	1,010		2,686	3,591	5,062	4,318
Interest	9,035	9,115	11,085	10,631	11,517	13,526	14,672
Renewals	-	4,569	9,551	9,302	9,302	5,938	6,449
Sinking Fund	-	-	-	-	-	5,297	5,661
Contingencies	-	-	-	149	225	253	241
Totals	$14,308	$18,115	$28,008	$29,101	$31,724	$39,746	$42,392

It will be noted that in the year 1920 there is a small difference between the total revenue and the total cost of power amounting to $581.70, which represents the loss on power sold to the Crushed Stone Company, Limited, undistributed to municipalities. It is explained that this amount has been transferred to the reserve for contingencies, thus making the total revenues and total costs of power balance in each year.

Percentage Costs of Power.

The table on page 36 and the sheet of curves included as page 35 show the



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WASDELL'S SYSTEM

TOTAL ANNUAL COSTS

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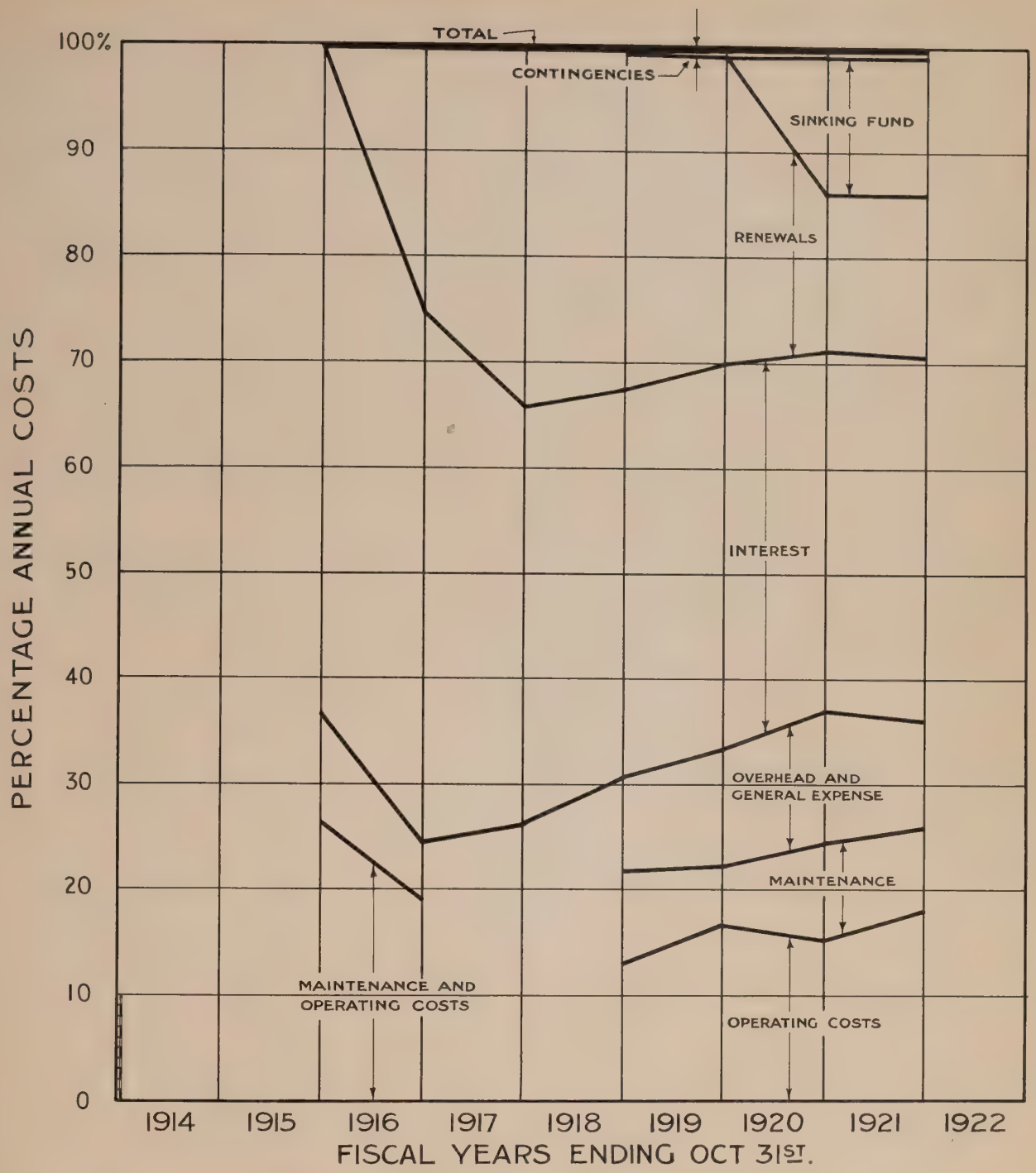

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WASDELL'S SYSTEM
ANNUAL COSTS SUBDIVIDED BY PERCENTAGES

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cost figures as percentages of the total cost of power per annum, and these are included as a method of comparison with other systems or similar properties.

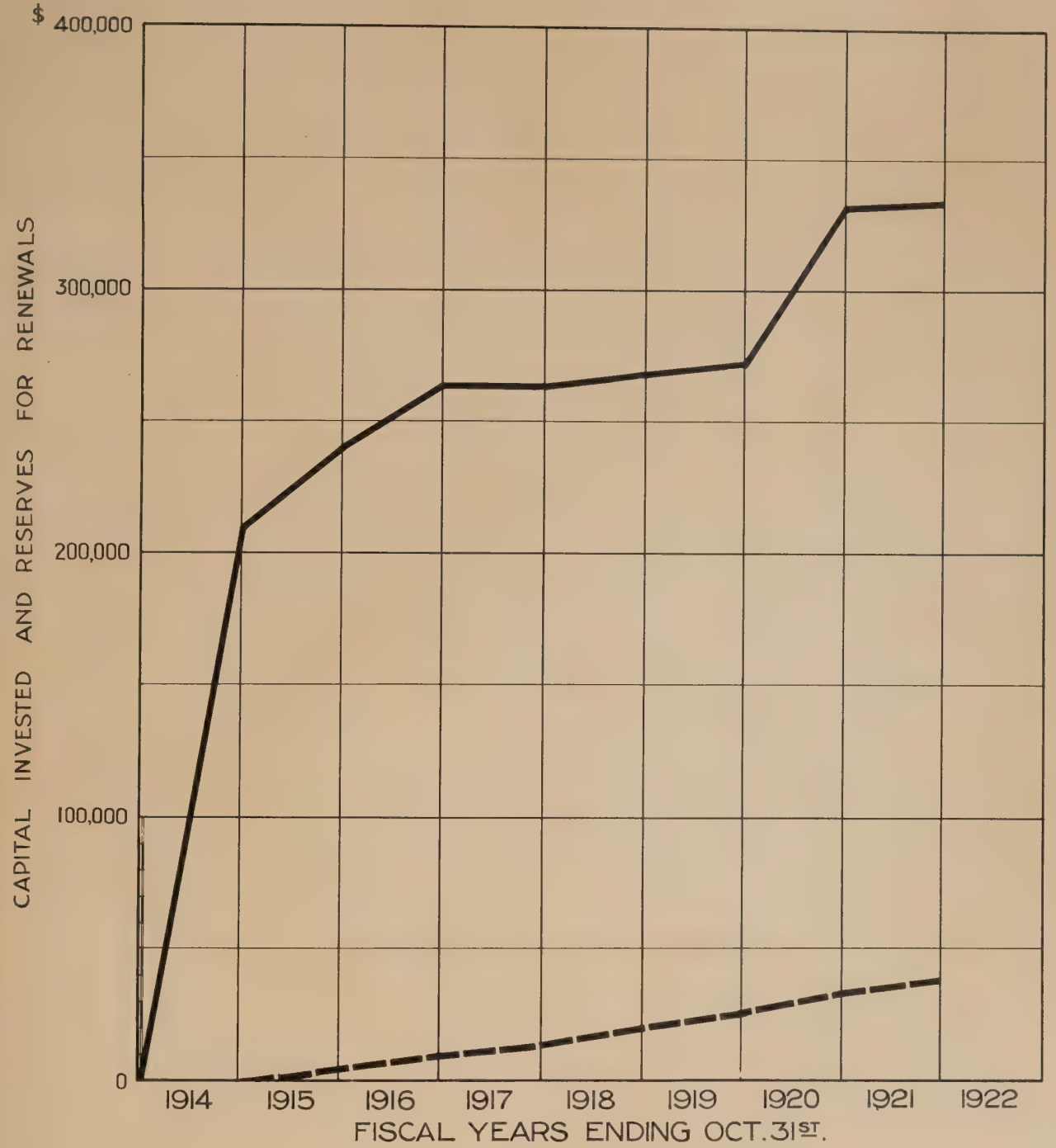
Table of Annual Costs Subdivided by Percentages

	Fiscal Years Ending October 31st,						
	1915	1916	1917	1918	1919	1920	1921
Operation	26.6	19.1	26.3	13.1	16.8	16.4	18.1
Maintenance				8.7	5.5	9.0	7.9
Overhead and General Expense	10.2	5.6		9.2	11.5	12.7	10.2
Interest	63.2	50.1	39.6	36.6	33.4	34.1	34.6
Renewals	-	25.2	34.1	31.9	29.3	14.9	15.2
Sinking Fund	-	-	-	-	-	13.3	13.4
Contingencies	-	-	-	.5	.7	.6	.6
Totals	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.3%

Analysis of Reserve Accounts.

Renewals Account.

The following table and the sheet of curves included as page 37 show the amounts set aside as reserve for renewals as they exist at the present time on the books of the Hydro-Electric Power Commission. As stated on page 12 in the report of Price, Waterhouse & Co., the balance in the reserve for renewals of the Wasdell's System amounted to $38,973.73 at October 31st, 1921, after giving effect to the adjustment discussed below, and may be briefly summarized as follows:



TOTAL INVESTED CAPITAL
TOTAL RENEWAL RESERVES INCLUDING INTEREST

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WASDELL'S SYSTEM

RESERVES FOR RENEWALS

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Table of Reserve for Renewals

Period	Annual Accrued Based upon 2% of the Capital Investment.	Interest at 4%	Total
1915 to October 31st, 1916	$ 9,522.91	$ 180.70	$ 9,703.61
Fiscal Year Ending October 31st,			
1917	5,259.68	388.14	5,647.82
1918	5,315.37	614.05	5,929.42
1919	5,315.30	851.23	6,166.53
1920	5,938.36	1,097.88	7,036.24
1921	6,449.28	1,379.34	7,828.62
Total	$37,800.90	$4,511.34	$42,312.24
Less miscellaneous deductions			3,338.51
Balance at October 31st, 1921			$38,973.73

During the period from the commencement of operations, to October 31st, 1919, the additions to the reserve for renewals in respect of the properties of the System, were provided through inclusion, in the cost of power to the municipalities, of an annual charge of 3½ per cent. on the capital investment. Interest at the rate of 4 per cent. per annum on the balance in the reserve account is credited to that account.

After a re-classification of the properties, as reflected in the book accounts as at October 31st, 1920, made by the Engineering Department of the Commission, the Commission, on the advice of its engineers in the fiscal year ending October 31st, 1920, reduced the annual renewal rate from 3½ per cent. to 2 per cent. on the capital investment, while the interest rate of 4 per cent. remained unchanged. The accounts of the Commission were so adjusted that the rate of 2 per cent. was made effective from 1914 to October 31st,

During the period from the commencement of operations, to October 31st, 1919, the additions to the reserve for renewals in respect of the properties of the System, were provided chiefly from insurance, in the case of power to the municipalities, of an annual charge of 5% per annum, on the capital invested. Interest at the rate of 4 per cent. per annum on the balance in the reserve account is credited to that account.

After a re-classification of the properties, as referred to in the body of the Consolidation, the Commission, on the closing of the customers' Department of the accounts as at October 31st, 1920, made by the Supervising Department of the Consolidation, the Commission, on the closing of the customers' Department of the to 4 per cent. on the annual investment, while the interest rate of 4 per cent. remained unchanged. The accounts of the Commission were as follows:

over the year of 4 per cent. The main difference from 31st to October 31st,

1919, and the same renewal rate has obtained to October 31st, 1921.

The amount of the adjustment for the period from 1914 to October 31st, 1919, resulted in a decreased cost of power to the various municipalities amounting to $20,585.60, and this amount has been credited to the municipalities.

The sinking fund method of making additions to the reserve at the rate of 2 per cent. together with interest at 4 per cent. per annum on the balance in the reserve account, is equivalent to a so-called straight line provision of approximately 3½ per cent. for a period of twenty-eight years.

Sinking Fund.

The study of the finances of the System shows that a reasonable amount has been set aside as sinking fund to provide for the financial obligations concerning the properties. The total amount is given in the Price, Waterhouse & Co. report as $11,170 for the Wasdell's System, and $611 for the Wasdell's rural lines. The sum of $11,170 is the aggregate amount of the sinking fund collectible at October 31st, 1921 from five municipalities having taken power for six years or longer, the initial charge being made in the sixth year's power cost, and it includes a sum of $3,337 included as part of the cost of power to the Severn System, and $2,435 from the Crushed Stone Company, Limited. The sinking fund charges deferred at October 31st, 1921, amounted to $191 in respect of the Municipality of Kirkfield, the deferment being because the five-year period had not elapsed.

The sinking fund reserve of the Wasdell's rural lines at October 31st,

1921, amounting to $611, represents accumulations from 1918 to 1921 with interest.

The question of the Severn System and private companies being charged with sinking fund, and so, theoretically at least, obtaining an equity in the Wasdell's System, should be studied and the accounts adjusted if necessary.

Reserve for Contingencies.

A study of the accounts of the System shows that up to the end of 1921, a total reserve for contingencies had been set aside amounting to $15,342 made up of an annual charge of 25 cents per horse-power on the average power billed to the municipalities and to sundry customers, and of certain profits realized on sales to sundry customers, together with the profit on sales of miscellaneous equipment, and an allowance for interest at four per cent. per annum. From this sum has been deducted $15,102, including $14,519 expended in 1920 in stringing aluminum cable on a large portion of the System and $582 to meet losses in 1920 on power sold to the Crushed Stone Company, Limited.

Considering the heavy losses which might be occasioned, through catastrophe, it is felt that the total amount at the credit of this fund, namely $241.00 should be augmented by increasing the small allowance for contingencies, and when a reserve of say $5,000 to $10,000 will have been built up, the rates can be re-adjusted to suit the conditions found after several further years of experience.

Discussion of Deficits and Surpluses.

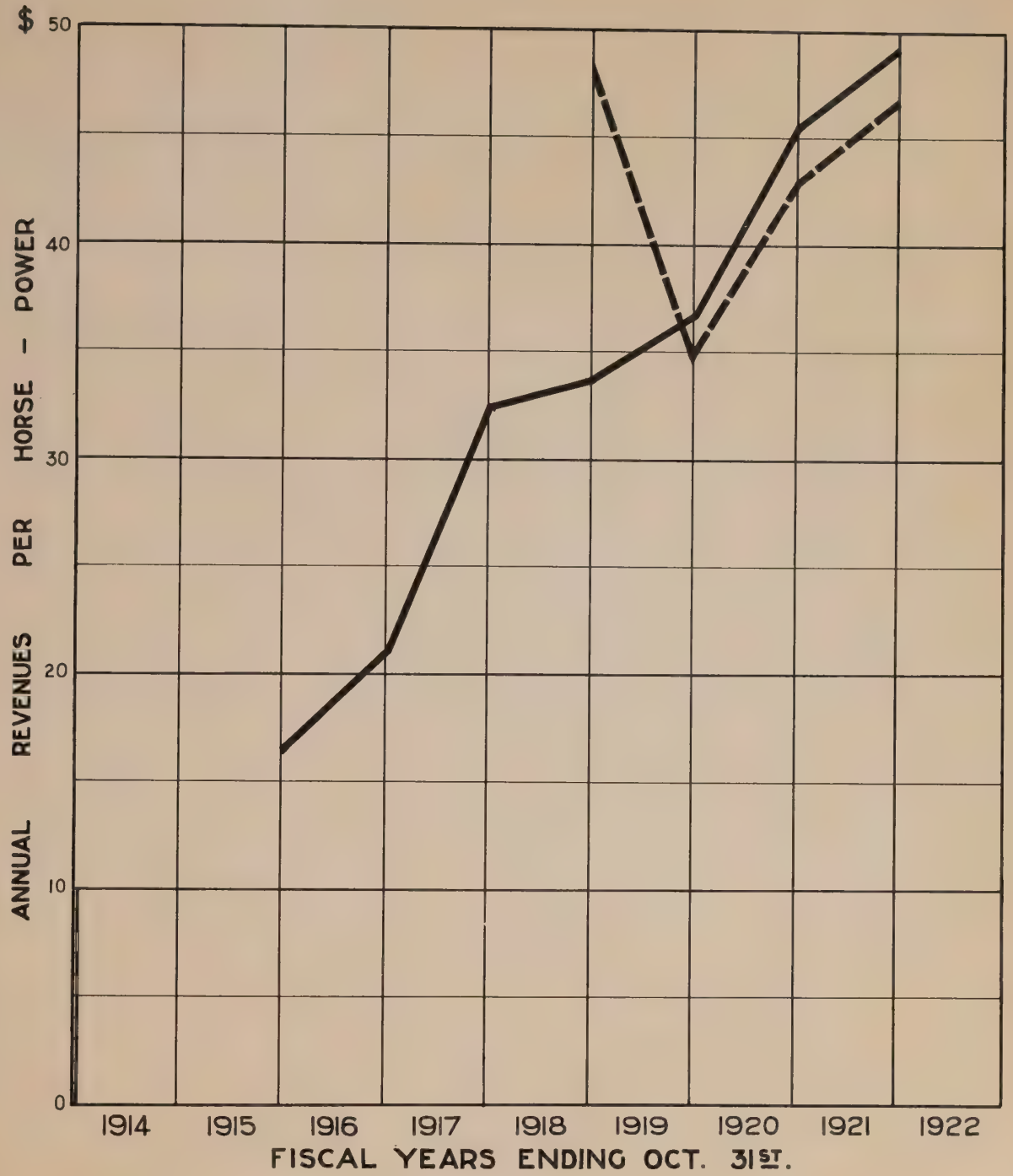
The records show that the System as a whole has been billed with the cost of power in accordance with the book-keeping methods of the Hydro-Electric Power Commission since 1918, and that there are now no deficits nor surpluses for the System as a whole. This does not take into account the local distribution in the various municipalities which is done by the municipality itself or by a separate commission in such municipality, and where the profits or losses are not included in the accounts of the Hydro-Electric Power Commission for the Wasdell's System.

Revenues and Costs per Horse-power per Annum.

In order to reduce the total revenues and total costs of operation to a basis where these would be comparable with other systems, and to agree with the usual practice of similar companies and of distribution authorities, a set of curves has been prepared to show the revenue per horse-power per annum for different bases of horse-power.

In a similar way the total costs have been reduced to costs per horse-power per annum for different bases of horse-power, and have also been analyzed to show the total annual costs subdivided into fractional amounts chargeable against each kind of expense based on the horse-power rating of the plant and also on the average horse-power billed. The following diagrams with the tables of figures for each show these various items in detail.

The various revenues for each classification of horse-power are given



REVENUE PER H.P. DEVELOPED
" " " " BILLED

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WASDELL'S SYSTEM
REVENUES PER H.P. PER ANNUM
VARIOUS H.P. BASES

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in the table below, and on the sheet of curves included as page 42 hereof.

Table of Revenues per Horse-power per Annum

	Fiscal Years Ending October 31st,						
	1915	1916	1917	1918	1919	1920	1921
Developed	$18.65	$21.10	$32.58	$33.83	$36.38	$45.58	$49.29
Billed	-	-	-	48.71	35.21	43.10	46.90

Annual Costs per Horse-power.

The tables on page 44, and the three sheets of curves included as pages 45, 46 and 47 show the details of the costs per horse-power per annum on different bases. The figures from which these curves were plotted are the figures for the operating costs given in the table on page 33 divided by the figures for the various classes of horse-power already given in the text. The sheet of curves included as page 45 indicates the total costs per horse-power per annum for the different classifications of horse-power already discussed. It will be noted that the total cost per horse-power in the fiscal year 1920 does not balance with the total revenue per horse-power on account of the fact that in this year a small loss was shown on the power supplied to the Crushed Stone Company, Limited, but this was later transferred to the reserve for contingencies.

The sheet of curves on page 46 entitled "Subdivided Costs per Annum per H.P. Developed", indicates the subdivision of the total annual costs as between operating, maintenance, overhead and general expense, interest, renewals, sinking fund and contingencies, divided by the total amount of horse-power

developed in the Wasdell's Falls plant. Similarly the sheet of curves included as page 47 indicates the subdivided costs per horse-power billed.

Table of Total Costs per Horse-power per Annum

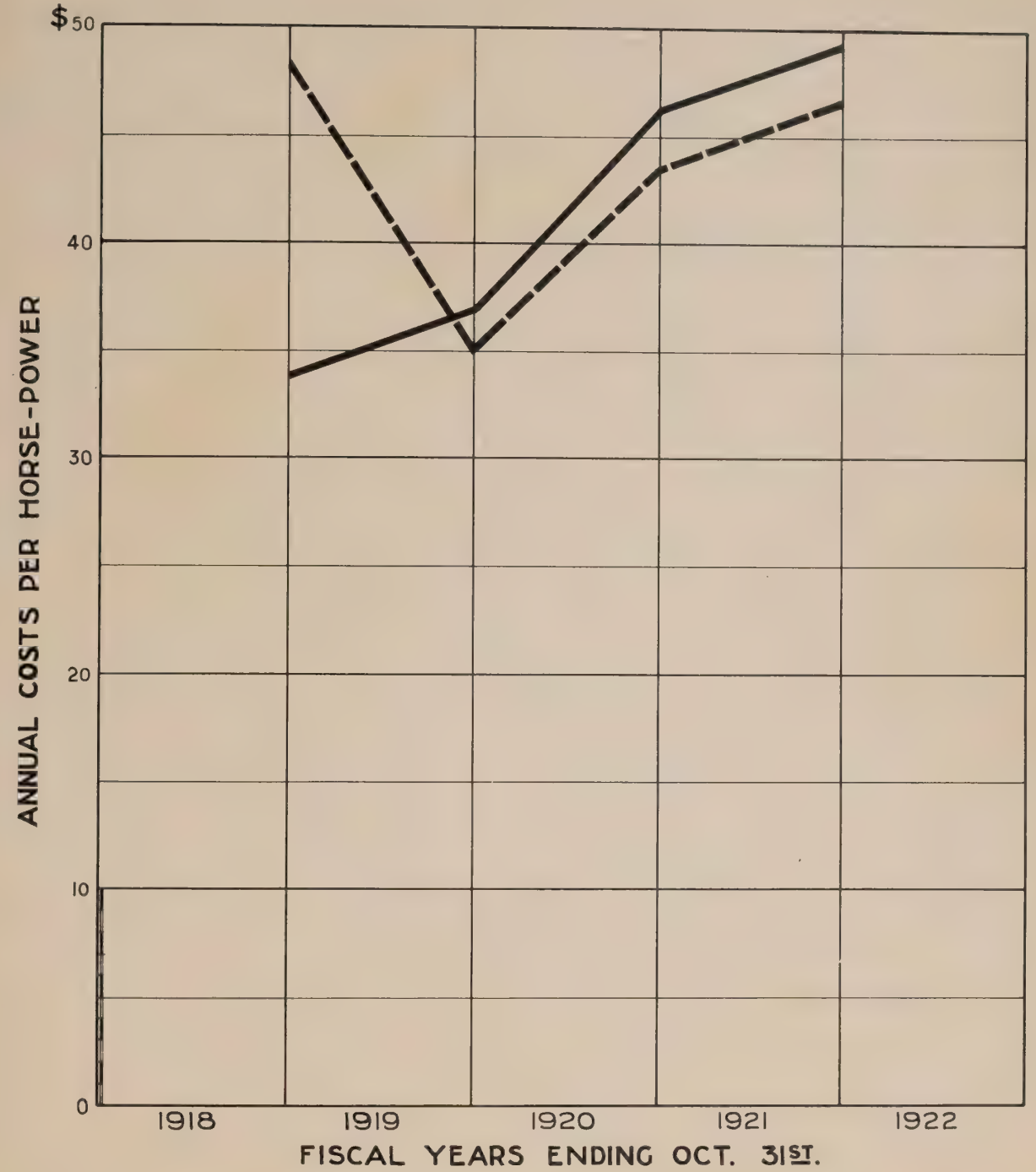
	Fiscal Years Ending October 31st, 1918	1919	1920	1921
H.P. Developed	$33.83	$36.88	$46.20	$49.29
H.P. Billed	48.71	35.21	43.67	46.90

Table of Subdivided Costs per Annum per Horse-power Developed

	Fiscal Years Ending October 31st, 1918	1919	1920	1921
Operation	$ 4.42	$ 6.23	$ 7.10	$ 8.97
Maintenance	2.94	2.02	4.15	3.89
Overhead and General Expense	3.13	4.19	5.88	5.02
Interest	12.35	13.41	15.72	17.07
Renewals	10.82	10.82	6.90	7.46
Sinking Fund	-	-	6.16	6.58
Contingencies	.17	.21	.29	.28
Totals	$33.83	$36.88	$46.20	$49.29

Table of Subdivided Costs per Annum per Horse-power Billed

	Fiscal Years Ending October 31st, 1918	1919	1920	1921
Operation	$ 6.36	$ 5.94	$ 6.71	$ 8.52
Maintenance	4.25	1.93	3.92	3.69
Overhead and General Expense	4.50	3.99	5.57	4.77
Interest	17.82	12.79	14.86	16.23
Renewals	15.53	10.31	6.52	7.15
Sinking Fund	-	-	5.81	6.28
Contingencies	.25	.25	.28	.26
Totals	$48.71	$35.21	$43.67	$46.90



COSTS PER H.P. DEVELOPED
• • • • BILLED

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WASDELL'S SYSTEM

COSTS PER H.P. PER ANNUM, VARIOUS H.P. BASES

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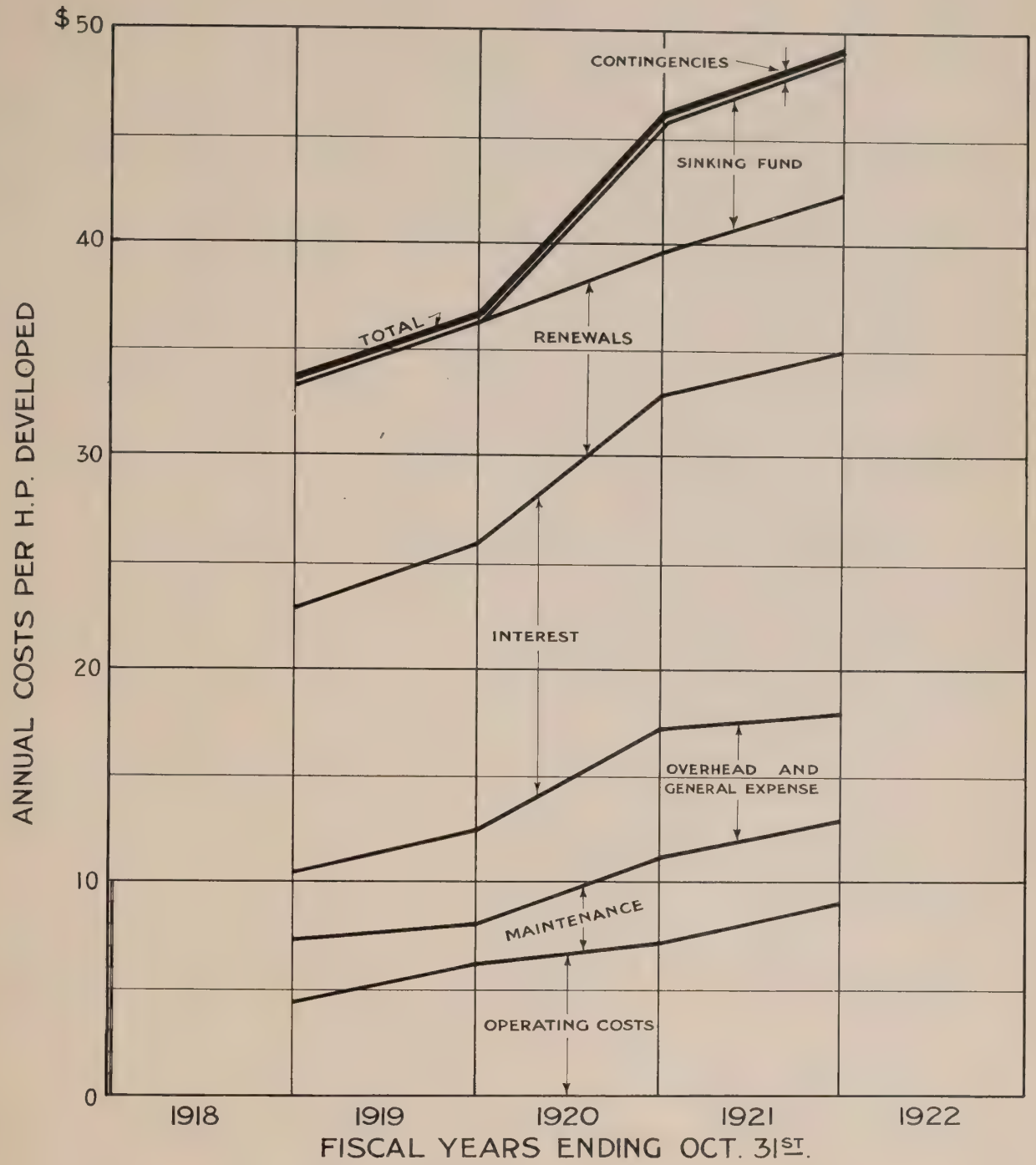

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WASDELL'S SYSTEM
SUBDIVIDED COSTS PER ANNUM PER H.P. DEVELOPED

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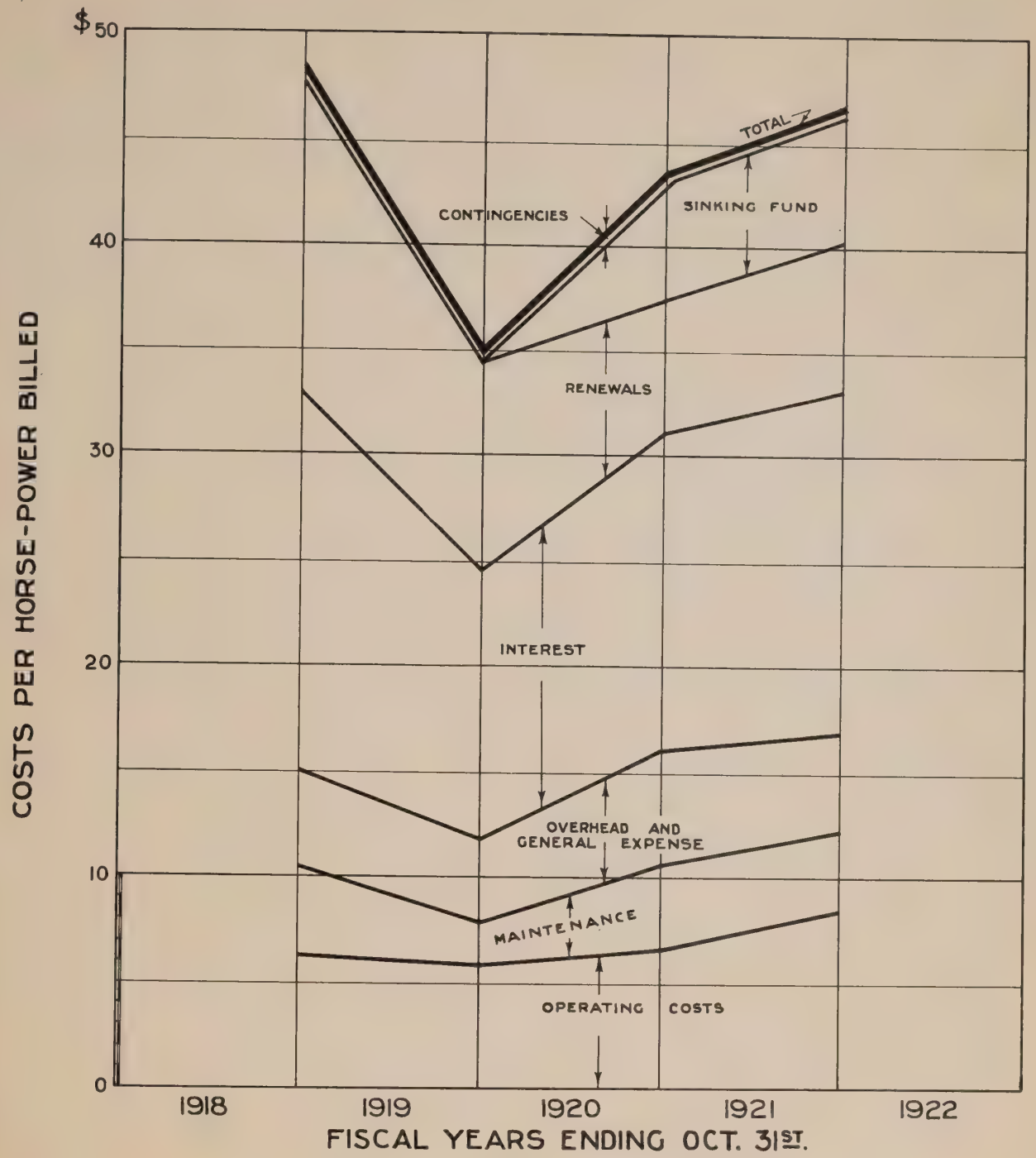

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WASDELL'S SYSTEM
SUBDIVIDED COSTS PER ANNUM PER H.P. BILLED

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CONSULTING ENGINEERS

Kilowatt-hour Data and Annual Revenues and Costs per Kilowatt-hour.

The engineers of the Hydro-Electric Power Commission state that prior to 1922 there is no reliable record of the kilowatt-hours supplied to the Wasdell's System. They have estimated that in the fiscal year 1922, the total kilowatt-hours generated by the Wasdell's plant was 3,512,089 and the total kilowatt-hours supplied to the Wasdell's System was 1,444,249. The revenue and cost of power for the year 1922 are not available, but if the kilowatt-hours generated in 1921 is assumed to be the same as that generated in 1922, then the revenue per kilowatt-hour generated in the Wasdell's Falls station for the year 1921 may be estimated as 1.2 cents, and since there was no surplus or deficit in that year, this would also represent the total cost per kilowatt-hour generated.

The tables on page 49 show the kilowatt-hours per consumer supplied for different purposes in the various municipalities of the Wasdell's System for the year 1921, and also show the kilowatt-hours consumed for various classes of service averaged for the whole of the Wasdell's System from 1918 to 1921 inclusive. The figures indicate the difficulty of comparing one place with another, as will be seen by the wide variation in the details given for the various places.

Table of Power Consumption by Municipalities, Calendar Year 1921

Place	K.W.H. per Domestic Consumer	K.W.H. per Commercial Light Consumer	Horse-power per Power Consumer
Beaverton	330	697	9
Brechin	298	368	21
Cannington	336	470	6
Kirkfield	195	718	-
Sunderland	206	282	15
Woodville	246	414	16.5

Table of Kilowatt-hour Consumption - Various Classes of Consumers

	Calendar Years					
	1916	1917	1918	1919	1920	1921
K.W.H. per Domestic Light Consumer	151	171	220	268	337	297
K.W.H. per Commercial Light Consumer	248	332	318	450	466	484

Summary.

A summary of a number of the more salient points which have been studied and discussed in the foregoing report may be of advantage in continuing the consideration of the economics of the Wasdell's System. They are as follows:

(1) The recorded capital costs of the generating plant at Wasdell's Falls show somewhat high construction costs even for such a small, low-head plant, and now stand at about $165 per horse-power but this figure is not unreasonable.

(2) Capital costs for 1922 and 1923 amounting to about $155,000 will, if carried out as contemplated, make the total investment in the Wasdell's System approximately $490,000 at October 1923. Of this total cost about $92,000 or nearly twenty per cent. is for rural lines.

(3) To facilitate future economic studies, and to assist in operating efficiency, it would be well to consider keeping accurate records of kilowatt-hours used at each principal consuming point on the System.

(4) The market for power has been well covered in the district. The density indicates a high percentage of consumers per capita of population. The demand for electricity is apparently still growing and indications are that further sources of power supply must soon be provided. The ultimate demand for power and the ultimate sources of supply should be considered in the near future because there are no local power sites which can be developed economically.

(5) In this System the reserve for renewals has already been adjusted to meet the viewsof the engineers of the Commission, who considered that an annual renewal rate of 3 per cent. on the capital investment was sufficient to meet the requirements of the System instead of the former rate of 3½ per cent.

(6) The reserve for contingencies has been practically wiped out by the expenditure involved in stringing aluminum conductors on a large part of the transmission system. The reserve for contingencies might with advantage be increased and yearly results noted so as to eventually devise a proper allowance for the fund.

(7) Operating records indicate that the System is being operated so as to supply power at cost, there be ng practically no difference between total revenues and total costs as shown in the Commission's books.

(8) The question of sinking funds should be studied in its relation to the cases of the Severn System and of those individual consumers who are apparently building up an equity in the System without actually being partners in it.

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